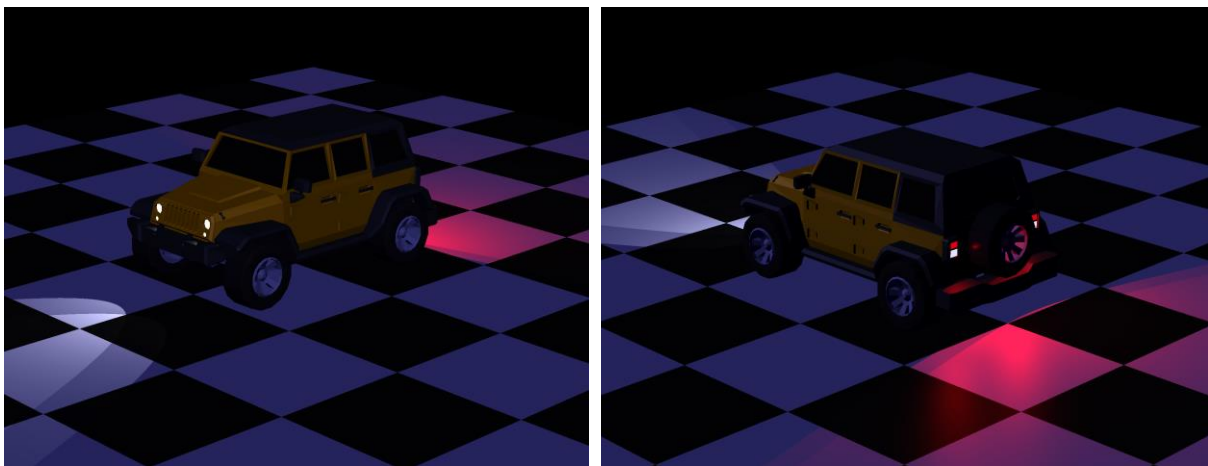


## Proseminar Visual Computing Winter Semester 2021

### *CG Assignment 2*

Hand-out: December 08, 2021

Hand-in: December 21, 2021



### Topics

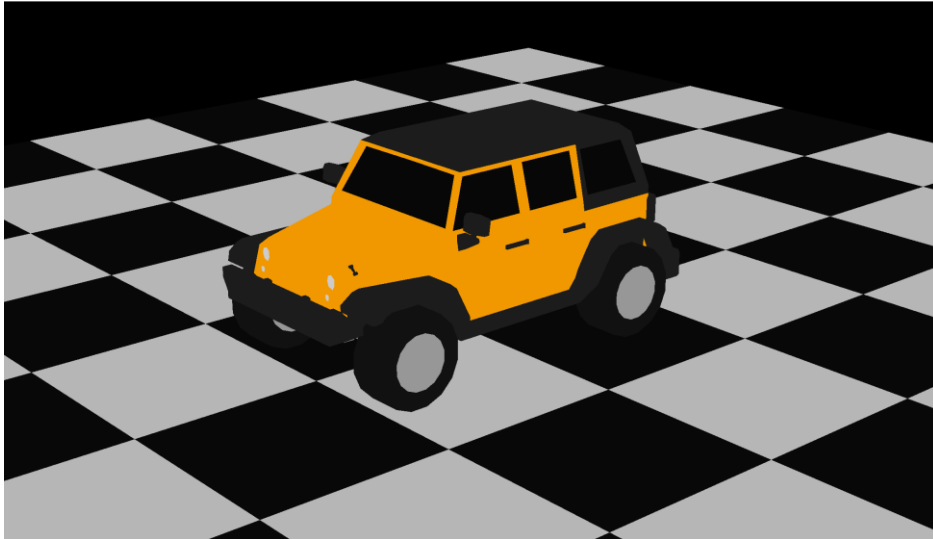
- Lighting and Materials
- Shader programming

### Outline

The goal of the Computer Graphics assignments of the Visual Computing PS is to build an animated car. This work is divided in 3 steps. Each step corresponds to a programming assignment. The objective of this assignment is to implement *Blinn-Phong Illumination* in the *Fragment Shader* in GLSL using material properties of the .obj data format. Furthermore, multiple light sources should be implemented (one directional light and four spotlights).

### Template code

A template code is provided with this assignment. It loads the car mesh and its material properties from an .obj file. The car controls from the previous assignment are already implemented. Currently, the fragment shader sets the fragment's color according to the diffuse material color.



## Tasks

1. Implement *Blinn-Phong* illumination in the *Fragment Shader* for a directional light source with the material properties (color values and shininess) given in the car model (loaded from an .obj (.mat) file).  
Find color values and direction for the light source in order to emulate the lighting condition during the day, evening, and night. You should be able to switch between them by pressing a key.
2. Next, add point light sources with decaying intensity. They should be placed slightly ahead of the front and rear lights of the car. Their color should match the one of the emissive materials in the car model (white, red). You will need to update the position of these point lights when the car moves. At last, add a toggle (on key press) to turn the point lights on and off.
3. Finally, change the point lights to spotlights. You can implement this without a smooth edge and simply cut the lights power if a fragment is not in the light cone (defined with a direction and a cut-off angle).  
You can direct the spotlights slightly to the ground in order to have a more visible light cone.



## Implementation Remarks

Make sure that your code is clear and readable. Write commentaries when necessary. Your solution should contain a readme file with names of the team members, list of keyboard controls, and any explanation that you think is necessary for the comprehension of the code.

## Submission and Grading

Submission of your solution is due on December 21<sup>th</sup>, 2021 (23:59). **Submit the sources** (i.e., only the content of the *src* folder) in a ZIP archive via OLAT. Do not submit the executable and the content of the *build* folder. Do not submit the external dependencies either. Both folder and archive should be named according to the following convention:

*Folder:* **CGA2\_<lastname1>\_<lastname2>\_<lastname3>**

*Archive:* **CGA2\_<lastname1>\_<lastname2>\_<lastname3>.zip,**

where <lastname1>, etc. are the family names of the team members. Development in teams of two or three students is requested. Please respect the academic honor code. In total there are 15 marks achievable in this assignment distributed as follows:

- A directional light source (sun/moon) (**5 marks**)
- Point light sources attached to the car (**5 marks**)
- Spotlight sources (**3 marks**)
- Code readability, comments, and proper submission: (**2 marks**)

## Resources

- Lecture and Proseminar slides as well as code and information are available via OLAT.
- OpenGL homepage  
<http://www.opengl.org>
- OpenGL 3.3 reference pages  
<https://www.khronos.org/registry/OpenGL/specs/gl/glspec33.core.pdf>
- OpenGL Tutorial for Blinn-Phong Illumination (Phong Shading)  
<https://learnopengl.com/Lighting/Basic-Lighting>  
<http://www.opengl-tutorial.org/beginners-tutorials/tutorial-8-basic-shading/>
- GL Framework GLFW  
<https://www.glfw.org/documentation.html>

*Note: Be mindful of employed OpenGL and GLSL versions!*